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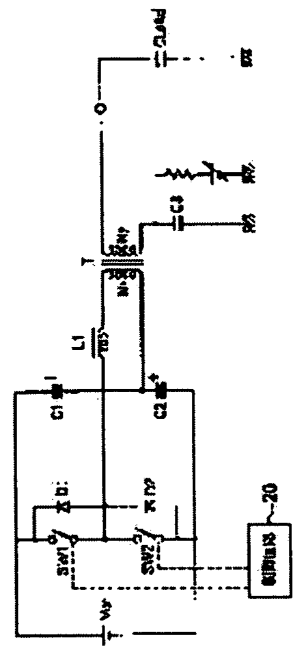
(54) AC BIAS POWER UNIT



(57)Abstract:
PURPOSE: To obtain an AC bias power unit which can be improved in efficiency by reducing the power loss of the unit by controlling the output voltage of the power unit by controlling the energizing time of a first and second energizing circuits.
CONSTITUTION: A first switching element SW1 is connected in series with the primary winding N1 of a voltage booster transformer T and, at the same time, a second switching element SW2 is connected in parallel with the winding N1 on the load side of the element SW1. A first and second diodes D1 and D2 which are opposed to each other are connected in parallel with the elements SW1 and SW2 and an inductor constituting a series LC resonance circuit together with a capacitive load is connected in series to the positive side of the winding N1 on the load side of the element SW2. In addition, a developing device, DC bias power source which applies a bias DC voltage across the developing device, and AC by-pass capacitor are connected in parallel to the secondary winding N2 of the transformer T.

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CLAIMS

[Claim(s)]
[Claim 1] The AC-bias power unit which is characterized by providing the following and which supplies the bias voltage of an alternating current to a capacitive load. The inductance which is connected to the load of the aforementioned capacitive in series, and constitutes LC series resonant circuit with the capacitive load concerned. The 1st switching circuit which energizes the aforementioned LC series resonant circuit in the right direction and in which energization time control is possible. The 1st energization circuit which formed the 1st diode which revives the series resonance energy after the energization end by the 1st switching circuit of the above. The 2nd diode which revives the series resonance energy after the energization end by the 2nd switching circuit which energizes the aforementioned LC series resonant circuit in the negative direction, and in which energization time control is possible, and the 2nd switching circuit of the above.
[Claim 2] The AC-bias power unit given in the 1st term of a claim characterized by having arranged the pressure-up transformer between the load of the aforementioned capacitive, the 1st, and 2nd energization circuits.
[Claim 3] The AC-bias power unit given in the 2nd term of a claim to which the aforementioned inductance is characterized by the bird clapper from the leakage inductance of a pressure-up transformer.
[Claim 4] The AC-bias power unit characterized by constituting so that it may have the capacitor by which the end was connected to the alternating current high-pressure output side, and the other end was connected to the current rectifier circuit, the current which flows this capacitor may be rectified by the aforementioned rectifier circuit and the output voltage of an alternating current high voltage power supply may be controlled by this rectification output.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the AC-bias power unit for impressing an AC bias to the development counter used for electrophotography application equipments, such as an electrophotography copying machine and a printer.
[0002]
[Description of the Prior Art] Recently, the above-mentioned electrophotography copying machine is asked for the model which can be copied on an OHP sheet (transparent sheet made of synthetic resin for overhead projectors) etc. as a record form besides a regular paper while colorization, improvement in the speed, and the miniaturization have been required strongly in addition to high-definition-izing. As a color electrophotography copying machine which can reply to these demands Arrange an imprint drum near the photo conductor drum, and the toner image formed in photo conductor drum lifting is imprinted one by one on the record form held around the imprint drum. After piling up the toner image of four colors on a record form, there are some which were constituted so that a color picture might be copied by establishing these toner images on a record form.
[0003] This color electrophotography copying machine develops the electrostatic latent image formed in photo conductor drum lifting one by one one by one with the toner image of four colors, such as cyanogen Magenta yellow black, by arranging the development counter of four colors of rotary system in the unilateral of a photo conductor drum, and rotating these development counters. Moreover, the above-mentioned imprint drum holds a record form to the peripheral face of this imprint drum electrostatic by forming the peripheral face with the film made of synthetic resin. Furthermore, it is constituted so that the imprint corotron for imprinting to electrostatic the toner image formed in photo conductor drum lifting on the record form held around the imprint drum may be arranged in the interior of the above-mentioned imprint drum.
[0004] As an AC-bias power unit for impressing the bias voltage of an alternating current to the development counter used for this kind of color electrophotography copying machine etc. conventionally, there is a thing as shown in drawing 7 . By carrying out on-off control of the direct current voltage Vi impressed to the upstream coil N1 of the pressure-up transformer T, this is constituted so that induction of the predetermined alternating voltage may be carried out to the secondary coil N2 of the pressure-up transformer T and it may output to the development counter which is a load by making this alternating voltage into bias. Here, the development counter as a load impresses the AC-bias voltage which direct current voltage was made to **** to a development sleeve, and develops the electrostatic latent image of photo conductor drum lifting while it holds a toner like known on the periphery of the development sleeve which consists of a metal cylinder. Thus, since the development counter is equipped with the development sleeve which consists of a metal cylinder by which opposite arrangement is carried out with conductors, such as a photo conductor drum, it serves as a capacitive load which acts like a capacitor as a load.
[0005] Moreover, as the above-mentioned AC-bias power unit, the thing as shown in JP,57-124757,A is

also already proposed. In the development bias equipment of the electrostatic recording device which this equipment impresses bias voltage to a development counter, carries out the toner development of the electrostatic latent image formed on the record object to it, and performs electrostatic recording Alternating voltage which amplified the sinusoidal voltage obtained from a sinusoidal oscillator circuit by the amplifying circuit, and carried out the pressure up of this amplified voltage by the pressure-up transformer is made into the aforementioned bias voltage. It constitutes so that the output of an amplifying circuit may be carried out to regularity by the automatic-gain-control circuit which detects the output of a pressure-up transformer and adjusts the gain of the aforementioned amplifying circuit.
[0006]
[Problem(s) to be Solved by the Invention] However, in the case of the above-mentioned conventional technology, it has the following troubles. That is, in the case of the equipment concerning the AC-bias power unit and proposal which are shown in above-mentioned drawing 7 , after carrying out the pressure up of the input voltage Vi by the pressure-up transformer, it is constituted so that it may output to the development counter as a load etc. by making into AC-bias voltage this alternating voltage by which the pressure up was carried out. Therefore, the load of a development counter etc. was a capacitive load, in the case of the above-mentioned equipment, the energy loss for carrying out the charge and discharge of this capacitive load occurred in the form of heat, and there was a trouble that efficiency was bad in it. Especially, the electrostatic capacity of the development counter as a capacitive load is large, and since the impedance of a load moreover becomes small when the frequency of AC-bias voltage is high, the problem of an energy loss becomes remarkable.
[0007]
[Means for Solving the Problem] Then, the place which it was made in order that this invention might solve the trouble of the above-mentioned conventional technology, and is made into the purpose is by mitigating a power loss to offer the AC-bias power unit in which efficient-izing is possible.
[0008] Namely, invention given in the 1st term of a claim is set to the AC-bias power unit which supplies the bias voltage of an alternating current to a capacitive load. The inductance which is connected to the load of the aforementioned capacitive in series, and constitutes LC series resonant circuit with the capacitive load concerned, The 1st switching circuit which energizes the aforementioned LC series resonant circuit in the right direction and in which energization time control is possible, The 1st energization circuit which formed the 1st diode which revives the series resonance energy after the energization end by the 1st switching circuit of the above, The 2nd switching circuit which energizes the aforementioned LC series resonant circuit in the negative direction and in which energization time control is possible, The 2nd energization circuit which formed the 2nd diode which revives the series resonance energy after the energization end by the 2nd switching circuit of the above is provided, and by controlling the energization time of the above 1st and the 2nd energization circuit, it is constituted so that output voltage may be controlled.
[0009] For example, a pressure-up transformer can be arranged between the load of the aforementioned capacitive, the 1st, and 2nd energization circuits.
[0010] Moreover, as the aforementioned inductance, what consists of leakage inductance of a pressure-up transformer can be used, for example.
[0011] Furthermore, invention given in the 4th term of a claim has the capacitor by which the end was connected to the alternating current high-pressure output side, and the other end was connected to the current rectifier circuit, rectifies the current which flows this capacitor by the aforementioned rectifier circuit, and it is constituted so that the output voltage of an alternating current high voltage power supply may be controlled by this rectification output.
[0012] As the above 1st and 2nd switching element SW1 and SW2, switching elements, such as a transistor and FET, can be used, for example.
[0013] Moreover, although the parasitism diode built in FET can be used as the 1st diode of the above, and 2nd diode, for example, of course as such 1st diode and 2nd diode, you may use the usual diode element itself.
[0014]

[Function] In this invention, similarly, invention given in the 1st term of a claim or the 3rd term is constituted so that the inductor which constitutes an in-series LC resonance circuit with a capacitive load may be prepared. Since LC series resonant circuits also including a capacitive load are constituted, therefore, conventionally When the pressure up of the voltage supplied from a power supply is carried out and it is supplied to a load by the pressure-up transformer, Since the capacitive load itself constitutes a part of LC series resonant circuit to power having been consumed by movement of the charge to a load while repeating accumulation and discharge of a charge for a load, Since it becomes only the resistance component of LC series resonant circuit and stops being theoretically dependent on the electrostatic capacity of a load, efficient-ization of the power consumed is attained by mitigating a power loss.
[0015]
[Example] This invention is explained based on the example of illustration below.
[0016] Drawing 3 shows the color electrophotography copying machine which can apply the AC-bias power unit concerning this invention.
[0017] In drawing, 1 is a photo conductor drum. around this photo conductor drum 1 The primary electrification machine 2 uniformly charged in predetermined potential in the front face of the photo conductor drum 1, The picture exposure 3 for exposing a picture on the front face of this photo conductor drum 1 charged uniformly, and forming an electrostatic latent image in it, The development counter 4 of a rotary method developed with the toner image of four colors, such as cyanogen Magenta yellow black for developing the electrostatic latent image formed in the front face of the photo conductor drum 1 The corotron 5 before an imprint which adjusts the potential of the toner image formed in the front face of the photo conductor drum 1, and the surface potential of a photo conductor drum, The corotron 7 grade for electric discharge which eliminates the residual charge of the cleaner 6 which cleans the remains toner of photo conductor drum 1 front face etc., and the photo conductor drum 1 after the toner image was imprinted is arranged.
[0018] Moreover, near the above-mentioned photo conductor drum 1, the imprint drum 8 is arranged and the toner image formed on the photo conductor drum 1 is imprinted one by one on the record form 9 held around the imprint drum 8. The peripheral face is formed with the transparent film made of synthetic resin, and the above-mentioned imprint drum 8 holds the record form 9 to the peripheral face of this imprint drum 8 electrostatic. Furthermore, the imprint corotron 10 for imprinting to electrostatic the toner image formed on the photo conductor drum 1 on the record form 9 held around the imprint drum 8 is arranged in the interior of the above-mentioned imprint drum 8.
[0019] By the way, the AC-bias power unit which supplies the bias voltage of an alternating current to capacitive loads, such as a development counter of the above-mentioned color electrophotography copying machine The inductance which is connected to the load of the aforementioned capacitive in series, and constitutes LC series resonant circuit with the capacitive load concerned, The 1st switching circuit which energizes the aforementioned LC series resonant circuit in the right direction and in which energization time control is possible, The 1st energization circuit which formed the 1st diode which revives the series resonance energy after the energization end by the 1st switching circuit of the above, The 2nd switching circuit which energizes the aforementioned LC series resonant circuit in the negative direction and in which energization time control is possible, The 2nd energization circuit which formed the 2nd diode which revives the series resonance energy after the energization end by the 2nd switching circuit of the above is provided, and by controlling the energization time of the above 1st and the 2nd energization circuit, it is constituted so that output voltage may be controlled.
[0020] Drawing 1 shows one example of the AC-bias power unit concerning this invention.
[0021] In drawing, T shows a pressure-up transformer and DC power supply Vcc of predetermined voltage are impressed to the upstream coil N1 of this pressure-up transformer T. Moreover, while the 1st switching element SW1 is connected to the upstream coil N1 of the above-mentioned pressure-up transformer T in series, the 2nd switching element SW2 is connected to the load side in parallel rather than the 1st switching element SW1 concerned. Moreover, the 1st diode D1 of a retrose and the 2nd diode D2 are connected to the 1st switching element SW1 of the above, and the 2nd switching element SW2 at parallel, respectively. Furthermore, the inductor which constitutes an in-series LC resonance

circuit with a capacitive load is connected to the positive-electrode side of the upstream coil N1 in series rather than the 2nd switching element SW2 of the above at the load side. Moreover, while the 1st mass capacitor C1 is connected with the negative-electrode terminal of the upstream coil N1 in between, the 2nd mass capacitor C2 is connected to the negative-electrode terminal of the upstream coil N1 concerned in parallel in the positive electrode of above-mentioned DC power supply Vcc.
[0022] Moreover, the development counter as a load is connected to the secondary coil N2 of the above-mentioned pressure-up transformer T, and since the development counter as this load is equipped with the development sleeve which consists of a metal cylinder by which opposite arrangement is carried out with the conductor of photo conductor drum 1 grade as mentioned above, it serves as a capacitive load which acts like a capacitor as a load.
[0023] Furthermore, the direct-current bias power supply and the alternating current bypass capacitor for impressing direct-current bias voltage to a development counter are connected to the secondary coil N2 of the above-mentioned pressure-up transformer T in parallel.
[0024] Moreover, the 1st switching element SW1 of the above and the 2nd switching element SW2 are constituted so that on-off control may be carried out by the control circuit to predetermined timing.
[0025] In addition, switching elements, such as a transistor and FET, can be used as the above 1st and 2nd switching element SW1 and SW2.
[0026] Drawing 2 shows the primary equal circuit of the AC-bias power unit concerning this example.
[0027] As for Ls, in drawing, the leakage inductance of the upstream coil N1 and the secondary coil N2 and Cload show the electrostatic capacity of the development counter whose L0 is a load about the excitation inductance of the pressure-up transformer T in the inductance of the inductor L1 by which L1 was connected to the upstream coil N1 of the pressure-up transformer T, respectively.
[0028] In addition, as conditions on which this primary equal circuit is materialized, it is required to fill C3>Cload, C2>Cloadx(N2/N1) 2, L0>L1, and Ls. Here, it is L1+Ls=L.
[0029] In the above composition, AC-bias voltage is outputted as follows by the AC-bias power unit concerning this example. That is, in the above-mentioned AC-bias power unit, as shown in drawing 4 , since diodes D1 and D2 are reverse blocking states, while the current iL which flows an inductor L1 maintains the state of 0, in the "mode 0" in which the 1st and 2nd switching elements SW1 and SW2 are [both] OFF states, the voltage Vc of the capacitor Cload which is a load serves as the predetermined value Vc (0). Therefore, the voltage of P points becomes the value which added voltage 1/2Vcc of the 2nd capacitor C2 to the voltage Vc of the capacitor Cload which is a load, i.e., 1/2 Vcc+Vc, (0).
[0030] In the mode 1, next the "mode 1" in which only a predetermined time makes the 2nd switching element SW2 an ON state As shown in drawing 4 (f), the charge accumulated through the 2nd switching element SW2 at the 2nd capacitor C2 flows as current iL. Series resonance operation of the series resonant circuit which consists of leakage inductance Ls of the 2nd capacitor C2, load-carrying capacity Cload, and the pressure-up transformer T, an inductor L1, and the 2nd switching element SW2 is started, and a state changes like a lower formula. Here, it is omega= 1/. It considers as LC and gamma= [V(0)/ (1/2Vcc)].
[0031] Then, the current isw2 (t) which flows the 2nd switching element SW2 is isw2(t) =-iL (t), when the current iL (t) which flows Inductor L is taken in the direction shown in the solid line of drawing 2 . = (1 / 2 Vcc+V (0)) - It can express C/L-sinomegat (drawing 4 (b)). Alternating voltage Vc impressed to a load on the other hand (t) Vc(t) =(1 / 2 Vcc+V (0)) cosomegat-1/2Vcc It is set to =[(1+gamma) cosomegat-1] x1/2Vcc.
[0032] If the 2nd switching element SW2 is made into an ON state as it is, a state will change to the dashed line A of drawing 4 (a) like and loss of each part will be disregarded, the free vibration by the series resonant circuit of LC will continue. However, the 2nd switching element SW2 is made to turn off in this example when Vc(t) =0, i.e., the voltage of P points, is set to 1/2Vcc. Namely, time t which makes this 2nd switching element SW2 turn off Vc(t) =[(1+gamma)cosomegat-1] x1/2Vcc = since it is 0, Time t is t=1/omegacos-1{1/(1+gamma)}.
When it becomes, it is set up so that the 2nd switching element SW2 may be made to turn off.
[0033] the mode 2 -- the value of the current isw2 which was flowing Vc at the time of the end in "the

mode 1" (t), and the 2nd switching element SW2 in the "mode 2" in which this 2nd switching element SW2 is made to turn off, i.e., the initial value in "the mode 2", -- the above -- Vc(t) =0-iL(t) =isw2 (t) =(1/2Vcc+V(0))
- C/L-sin {omegacos-1[1/(1+gamma)]}
It becomes.
[0034] Moreover, the state of each part is expressed with a lower formula. That is, if the 2nd switching element SW2 is made to turn off, the excitation energy accumulated at an inductor L1 and leakage inductance Ls will return to a power supply Vcc side through diode D1. Therefore, the current iD1 (t) which flows the 1st diode D1 and voltage Vc of a load (t) iD1 (t) = - (1 / 2 Vcc+V (0))
- C/L-sin{omega (t-cos-1 [1/(1+gamma)]})
Vc(t) ={1-(1+gamma) cos[omega (-1 {1/(1+gamma) of t-cos)
It can express]}x1/2Vcc.
[0035] This the "mode 2" continues until the current iD1 which flows the 1st diode D1 is set to 0, as shown in drawing 4 (c). That is, it continues to t=cos -1 {1/(1+gamma)]}, and if the current iD1 which only this time t passes and flows the 1st diode D1 is set to 0, since "the mode 1" is charged in reversed polarity, the voltage Vc of a load (t) will be set to Vc(t) =-V (0). Therefore, the voltage of P points serves as 1 / 2 Vcc-V (0), as shown in drawing 4 (a).
[0036] After the end in in the mode 3, next "the mode 2", if the 1st and 2nd switching elements SW1 and SW2 are set [both] to OFF, as the state, i.e., the voltage of P points, of Vc(t) =-V at the end time in "the mode 2" (0) shows drawing 4 (a), the state of 1 / 2 Vcc-V (0) will be maintained.
[0037] Although it operates after that [mode 4] in the "mode 4" in which only a predetermined time makes the 1st switching element SW1 an ON state, like the "mode 1" in which only a predetermined time makes the 2nd switching element SW2 an ON state fundamentally Since the current which flows through the 1st switching element SW1 from DC power supply Vcc flows in the direction shown in drawing 2 as a solid line, polarity reverses the value and output voltage Vc (t) of Current iL which flow an inductance to the case in "the mode 1." That is, the value of the current iL which flows an inductance should be shown in drawing 4 (f). isw1(t) =iL (t)
= - (1 / 2 Vcc+V (0)) - It becomes C/L-sinomegat. Alternating voltage Vc impressed to a load on the other hand (t) Vc(t) =-(1 / 2 Vcc+V (0)) cosomegat-1/2Vcc It is set to =-[(1+gamma)cosomegat-1] x1/2Vcc.
[0038] If the 1st switching element SW1 is made into an ON state as it is, like the dashed line of B of drawing 4 (a), a state changes, and if loss of each part is disregarded, the free vibration by the series resonant circuit of LC will continue. However, the 1st switching element SW1 is made to turn off in this example when Vc(t) =0, i.e., the voltage of P points, is set to 1/2Vcc. That is, the time t which makes this 1st switching element SW1 turn off is t=1/omegacos-1{1/(1+gamma)} like "the mode 1."
It is alike and is set up.
[0039] the mode 5 -- although this the "mode 5" operates like "the mode 2" fundamentally, polarity reverses the value of the current iL which flows output voltage Vc (t) and an inductance to the case in "the mode 2"
[0040] That is, the value of the current isw1 which was flowing Vc at the time of the end in "the mode 4" (t) and the 1st switching element SW1 in the "mode 5" in which the 1st switching element SW1 of the above is made to turn off, i.e., the initial value in "the mode 5", is Vc(t) =0-iL(t) =isw2 (t) from the above.
=(1/2Vcc+V(0))
- C/L-sin {omegacos-1[1/(1+gamma)]}
It becomes. In addition, the current iD2 (t) which flows the 2nd diode D2, and the voltage Vc of a load (t) are reversed to the case in "the mode 2."
[0041] This the "mode 5" continues until the current iD2 which flows the 2nd diode D2 is set to 0, as shown in drawing 4 (e). That is, it continues to t=cos -1 {1/(1+gamma)]}, and if the current iD2 which only this time t passes and flows the 2nd diode D2 is set to 0, the voltage Vc of a load (t) will be set to Vc(t) =V (0). Therefore, the voltage of P points serves as 1 / 2 Vcc+V (0), as shown in drawing 4 (a).

[0042] the mode -- six -- again -- this -- " -- the mode -- six -- " -- fundamental -- " -- the mode -- zero -- " -- the same -- operating -- although -- output voltage -- Vc -- (-- t --) -- a value -- " -- the mode -- zero -- " -- it is -- a case -- receiving -- having been reversed -- + -- Vc -- (-- zero --) -- becoming .
[0043] Then, "from the mode 1" to the "mode 6" will be repeated successively.
[0044] Thus, since it operates as mentioned above, the AC-bias power unit concerning the above-mentioned example is the ON time of the 2nd switching element SW2 in "the mode 1", and the ON time of the 1st switching element SW1 in "the mode 4" like the above Ton=(1-/omega) cos-1{1/(1+gamma)]}

By setting up so that it may become, the voltage Vcpp between peaks of the alternating voltage impressed to load-carrying capacity Cload is Vcpp=2V (0) so that clearly from drawing 4 (a).
= It will be given by 2gamma and (1/2) Vcc=gamma-Vcc. namely, the thing for which a control parameter is set to gamma -- ON time Ton=(1-/omega) cos- of the 1st switching element SW1 and the 2nd switching element SW2 -- when referred to as 1 {1/(1+gamma)]}, the voltage Vcpp between peaks of output voltage will be controlled by Vcpp=gamma-Vcc as a primary equivalent of an equal circuit
[0045] Drawing 5 is the graph of the oscilloscope in which the alternating voltage generated according to one example of the AC-bias power unit concerning this example is shown.
[0046] Since in-series LC resonance circuits also including a capacitive load are constituted from this example, conventionally Since the capacitive load itself constitutes a part of in-series LC resonance circuit to power having been consumed by movement of the charge to a load while repeating accumulation and discharge of a charge for a load, Since it becomes only the resistance component of an in-series LC resonance circuit and stops being theoretically dependent on the electrostatic capacity of a load, efficient-ization of the power consumed is attained by mitigating a power loss.
[0047] Drawing 8 or drawing 10 shows the modification of this example.
[0048] In the modification of drawing 8 , capacitors C1 and C2 are not formed in the upstream coil N1 of the pressure-up transformer T, instead two DC power supplies Vcc and Vcc are formed. Moreover, in the modification of drawing 9 , the partial pressure resistance R1 and R2 for generating the energization voltage of the first energization circuit is connected to the upstream coil N1 of the pressure-up transformer T in parallel with DC power supply Vcc instead of the capacitor C1. Furthermore, while the upstream coil N1 of the pressure-up transformer T is divided into two and the plus side of DC power supply Vcc is connected to the middle terminal of the upstream coil N1 concerned in the modification of drawing 10 The minus side of DC power supply Vcc is connected to the ends child of the upstream coil N1 concerned through the 1st of parallel connection, the 1st as 2nd switching element SW1 and SW2, the 2nd transistor and the 1st, and 2nd diodes.
[0049] If second example drawing 6 shows the second example of this invention and the same sign is attached and explained to the same portion as the aforementioned example, in this example, stabilization of output voltage is possible for it.
[0050] That is, by stabilizing the supply voltage Vcc impressed to the upstream coil N1 of a pressure-up transformer, in order to stabilize the output voltage of the above-mentioned AC-bias power unit, the detection coil for detecting output voltage to the method and pressure-up transformer which stabilize output voltage indirectly is formed, and the method of controlling the supply voltage Vcc impressed to the upstream coil N1 of a pressure-up transformer etc. is used so that the output of this detection coil may be stable.
[0051] However, in both the cases of the above-mentioned former and the latter, since it has combination of a transformer, and the influence of the impedance of a transformer coil, it has the trouble that output voltage cannot be stabilized to change or variation of a load. Moreover, the trouble that in both the cases of the above-mentioned former and the latter it was required to make big electrostatic capacity of an alternating current bypass capacitor in order to change the variation in the alternating current component which appears in an output and to stop this under the influence of the variation in the electrostatic capacity of an alternating current bypass capacitor, temperature change, etc., if the alternating current bypass capacitor which makes direct-current bias voltage bypass an alternating current component is connected in parallel in order to make direct-current bias voltage **** on AC-bias

voltage was.
[0052] Then, in this example, while being able to stabilize output voltage to change and variation of a load, it aims at offering the AC-bias power unit which can prevent the variation in the alternating current component which appears in an output under the influence of the variation in the electrostatic capacity of an alternating current bypass capacitor, temperature change, etc.
[0053] Therefore, it has the capacitor by which the end was connected to the alternating current high-pressure output side, and the other end was connected to the current rectifier circuit, and the current which flows this capacitor is rectified by the aforementioned rectifier circuit, and it consists of this example so that the output voltage of an alternating current high voltage power supply may be controlled by this rectification output.
[0054] That is, in this example, as shown in drawing 6 , the capacitor C5 and diode D5 of a series connection are connected to the secondary coil N2 of a pressure-up transformer in parallel. Moreover, while the output voltage detected through diode D6 is outputted to the node of such capacitors C5 and diodes D5, resistance R1 and the capacitor C6 are connected to the detection output side of diode D6 in parallel.
[0055] therefore, the influence of the variation in the electrostatic capacity of the bypass capacitor which it will be given by Vdep=freq-C1 and Vpp-R1 if the output voltage detection voltage Vdep is Vdep<<Vpp, and will be connected to combination of Transformer T, the influence of the impedance of a transformer coil, or the secondary coil N2 of the pressure-up transformer T if the precision of the frequency freq of output voltage is good -- nothing -- output voltage -- being detectable .
[0056] If the precision of the frequency freq of output voltage is good in this example, thus, combination of Transformer T and influence of the impedance of a transformer coil, Or since direct-output voltage is detectable without the influence of the variation in the electrostatic capacity of the bypass capacitor connected to the secondary coil N2 of the pressure-up transformer T Precision can improve output voltage a constant pressure control by controlling the timing which turns on and off the above 1st and the 2nd switching element SW1 and SW2 by the aforementioned control circuit 20 based on this detected output voltage.
[0057] Since other composition and operations are the same as that of the first example of the above, the explanation is omitted.
[0058]
[Effect of the Invention] This invention consists of the above composition and operation, and can offer the AC-bias power unit in which efficient-izing is possible by mitigating a power loss.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the AC-bias power unit for impressing an AC bias to the development counter used for electrophotography application equipments, such as an electrophotography copying machine and a printer.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Recently, the above-mentioned electrophotography copying machine is asked for the model which can be copied on an OHP sheet (transparent sheet made of synthetic resin for overhead projectors) etc. as a record form besides a regular paper while colorization, improvement in the speed, and the miniaturization have been required strongly in addition to high-definition-izing. As a color electrophotography copying machine which can reply to these demands Arrange an imprint drum near the photo conductor drum, and the toner image formed in photo conductor drum lifting is imprinted one by one on the record form held around the imprint drum. After piling up the toner image of four colors on a record form, there are some which were constituted so that a color picture might be copied by establishing these toner images on a record form.
[0003] This color electrophotography copying machine develops the electrostatic latent image formed in photo conductor drum lifting one by one one by one with the toner image of four colors, such as cyanogen Magenta yellow black, by arranging the development counter of four colors of rotary system in the unilateral of a photo conductor drum, and rotating these development counters. Moreover, the above-mentioned imprint drum holds a record form to the peripheral face of this imprint drum electrostatic by forming the peripheral face with the film made of synthetic resin. Furthermore, it is constituted so that the imprint corotron for imprinting to electrostatic the toner image formed in photo conductor drum lifting on the record form held around the imprint drum may be arranged in the interior of the above-mentioned imprint drum.
[0004] As an AC-bias power unit for impressing the bias voltage of an alternating current to the development counter used for this kind of color electrophotography copying machine etc. conventionally, there is a thing as shown in drawing 7 . By carrying out on-off control of the direct current voltage Vi impressed to the upstream coil N1 of the pressure-up transformer T, this is constituted so that induction of the predetermined alternating voltage may be carried out to the secondary coil N2 of the pressure-up transformer T and it may output to the development counter which is a load by making this alternating voltage into bias. Here, the development counter as a load impresses the AC-bias voltage which direct current voltage was made to **** to a development sleeve, and develops the electrostatic latent image of photo conductor drum lifting while it holds a toner like known on the periphery of the development sleeve which consists of a metal cylinder. Thus, since the development counter is equipped with the development sleeve which consists of a metal cylinder by which opposite arrangement is carried out with conductors, such as a photo conductor drum, it serves as a capacitive load which acts like a capacitor as a load.
[0005] Moreover, as the above-mentioned AC-bias power unit, the thing as shown in JP,57-124757,A is also already proposed. In the development bias equipment of the electrostatic recording device which this equipment impresses bias voltage to a development counter, carries out the toner development of the electrostatic latent image formed on the record object to it, and performs electrostatic recording Alternating voltage which amplified the sinusoidal voltage obtained from a sinusoidal oscillator circuit by the amplifying circuit, and carried out the pressure up of this amplified voltage by the pressure-up transformer is made into the aforementioned bias voltage. It constitutes so that the output of an

amplifying circuit may be carried out to regularity by the automatic-gain-control circuit which detects the output of a pressure-up transformer and adjusts the gain of the aforementioned amplifying circuit.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] This invention consists of the above composition and operation, and can offer the AC-bias power unit in which efficient-izing is possible by mitigating a power loss.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the case of the above-mentioned conventional technology, it has the following troubles. That is, in the case of the equipment concerning the AC-bias power unit and proposal which are shown in above-mentioned drawing 7 , after carrying out the pressure up of the input voltage Vi by the pressure-up transformer, it is constituted so that it may output to the development counter as a load etc. by making into AC-bias voltage this alternating voltage by which the pressure up was carried out. Therefore, the load of a development counter etc. was a capacitive load, in the case of the above-mentioned equipment, the energy loss for carrying out the charge and discharge of this capacitive load occurred in the form of heat, and there was a trouble that efficiency was bad in it. Especially, the electrostatic capacity of the development counter as a capacitive load is large, and since the impedance of a load moreover becomes small when the frequency of AC-bias voltage is high, the problem of an energy loss becomes remarkable.
[0007]

[Translation done.]

* NOTICES *

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1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] Then, the place which it was made in order that this invention might solve the trouble of the above-mentioned conventional technology, and is made into the purpose is by mitigating a power loss to offer the AC-bias power unit in which efficient-izing is possible.
[0008] Namely, invention given in the 1st term of a claim is set to the AC-bias power unit which supplies the bias voltage of an alternating current to a capacitive load. The inductance which is connected to the load of the aforementioned capacitive in series, and constitutes LC series resonant circuit with the capacitive load concerned, The 1st switching circuit which energizes the aforementioned LC series resonant circuit in the right direction and in which energization time control is possible, The 1st energization circuit which formed the 1st diode which revives the series resonance energy after the energization end by the 1st switching circuit of the above, The 2nd switching circuit which energizes the aforementioned LC series resonant circuit in the negative direction and in which energization time control is possible, The 2nd energization circuit which formed the 2nd diode which revives the series resonance energy after the energization end by the 2nd switching circuit of the above is provided, and by controlling the energization time of the above 1st and the 2nd energization circuit, it is constituted so that output voltage may be controlled.
[0009] For example, a pressure-up transformer can be arranged between the load of the aforementioned capacitive, the 1st, and 2nd energization circuits.
[0010] Moreover, as the aforementioned inductance, what consists of leakage inductance of a pressure-up transformer can be used, for example.
[0011] Furthermore, invention given in the 4th term of a claim has the capacitor by which the end was connected to the alternating current high-pressure output side, and the other end was connected to the current rectifier circuit, rectifies the current which flows this capacitor by the aforementioned rectifier circuit, and it is constituted so that the output voltage of an alternating current high voltage power supply may be controlled by this rectification output.
[0012] As the above 1st and 2nd switching element SW1 and SW2, switching elements, such as a transistor and FET, can be used, for example.
[0013] Moreover, although the parasitism diode built in FET can be used as the 1st diode of the above, and 2nd diode, for example, of course as such 1st diode and 2nd diode, you may use the usual diode element itself.

[Translation done.]

OPERATION

[Function] In this invention, similarly, invention given in the 1st term of a claim or the 3rd term is constituted so that the inductor which constitutes an in-series LC resonance circuit with a capacitive load may be prepared. Therefore, since LC series resonant circuits also including a capacitive load are constituted, it is the former. When the pressure up of the voltage supplied from a power supply is carried out and it is supplied to a load by the pressure-up transformer, Since the capacitive load itself constitutes a part of LC series resonant circuit to power having been consumed by movement of the charge to a load while repeating accumulation and discharge of a charge for a load, Since it becomes only the resistance component of LC series resonant circuit and stops being theoretically dependent on the electrostatic capacity of a load, efficient-ization of the power consumed is attained by mitigating a power loss.

[Translation done.]

EXAMPLE

[Example] This invention is explained based on the example of illustration below.
[0016] Drawing 3 shows the color electrophotography copying machine which can apply the AC-bias power unit concerning this invention.
[0017] In drawing, 1 is a photo conductor drum. around this photo conductor drum 1 The primary electrification machine 2 uniformly charged in predetermined potential in the front face of the photo conductor drum 1, The picture exposure 3 for exposing a picture on the front face of this photo conductor drum 1 charged uniformly, and forming an electrostatic latent image in it, The development counter 4 of a rotary method developed with the toner image of four colors, such as cyanogen Magenta yellow black for developing the electrostatic latent image formed in the front face of the photo conductor drum 1 The corotron 5 before an imprint which adjusts the potential of the toner image formed in the front face of the photo conductor drum 1, and the surface potential of a photo conductor drum, The corotron 7 grade for electric discharge which eliminates the residual charge of the cleaner 6 which cleans the remains toner of photo conductor drum 1 front face etc., and the photo conductor drum 1 after the toner image was imprinted is arranged.
[0018] Moreover, near the above-mentioned photo conductor drum 1, the imprint drum 8 is arranged and the toner image formed on the photo conductor drum 1 is imprinted one by one on the record form 9 held around the imprint drum 8. The peripheral face is formed with the transparent film made of synthetic resin, and the above-mentioned imprint drum 8 holds the record form 9 to the peripheral face of this imprint drum 8 electrostatic. Furthermore, the imprint corotron 10 for imprinting to electrostatic the toner image formed on the photo conductor drum 1 on the record form 9 held around the imprint drum 8 is arranged in the interior of the above-mentioned imprint drum 8.
[0019] By the way, the AC-bias power unit which supplies the bias voltage of an alternating current to capacitive loads, such as a development counter of the above-mentioned color electrophotography copying machine The inductance which is connected to the load of the aforementioned capacitive in series, and constitutes LC series resonant circuit with the capacitive load concerned, The 1st switching circuit which energizes the aforementioned LC series resonant circuit in the right direction and in which energization time control is possible, The 1st energization circuit which formed the 1st diode which revives the series resonance energy after the energization end by the 1st switching circuit of the above, The 2nd switching circuit which energizes the aforementioned LC series resonant circuit in the negative direction and in which energization time control is possible, The 2nd energization circuit which formed the 2nd diode which revives the series resonance energy after the energization end by the 2nd switching circuit of the above is provided, and by controlling the energization time of the above 1st and the 2nd energization circuit, it is constituted so that output voltage may be controlled.
[0020] Drawing 1 shows one example of the AC-bias power unit concerning this invention.
[0021] In drawing, T shows a pressure-up transformer and DC power supply Vcc of predetermined voltage are impressed to the upstream coil N1 of this pressure-up transformer T. Moreover, while the 1st switching element SW1 is connected to the upstream coil N1 of the above-mentioned pressure-up transformer T in series, the 2nd switching element SW2 is connected to the load side in parallel rather

than the 1st switching element SW1 concerned. Moreover, the 1st diode D1 of a retrose and the 2nd diode D2 are connected to the 1st switching element SW1 of the above, and the 2nd switching element SW2 at parallel, respectively. Furthermore, the inductor which constitutes an in-series LC resonance circuit with a capacitive load is connected to the positive-electrode side of the upstream coil N1 in series rather than the 2nd switching element SW2 of the above at the load side. Moreover, while the 1st mass capacitor C1 is connected with the negative-electrode terminal of the upstream coil N1 in between, the 2nd mass capacitor C2 is connected to the negative-electrode terminal of the upstream coil N1 concerned in parallel in the positive electrode of above-mentioned DC power supply Vcc.
[0022] Moreover, the development counter as a load is connected to the secondary coil N2 of the above-mentioned pressure-up transformer T, and since the development counter as this load is equipped with the development sleeve which consists of a metal cylinder by which opposite arrangement is carried out with the conductor of photo conductor drum 1 grade as mentioned above, it serves as a capacitive load which acts like a capacitor as a load.
[0023] Furthermore, the direct-current bias power supply and the alternating current bypass capacitor for impressing direct-current bias voltage to a development counter are connected to the secondary coil N2 of the above-mentioned pressure-up transformer T in parallel.
[0024] Moreover, the 1st switching element SW1 of the above and the 2nd switching element SW2 are constituted so that on-off control may be carried out by the control circuit to predetermined timing.
[0025] In addition, switching elements, such as a transistor and FET, can be used as the above 1st and 2nd switching element SW1 and SW2.
[0026] Drawing 2 shows the primary equal circuit of the AC-bias power unit concerning this example.
[0027] As for Ls, in drawing, the leakage inductance of the upstream coil N1 and the secondary coil N2 and Cload show the electrostatic capacity of the development counter whose L0 is a load about the excitation inductance of the pressure-up transformer T in the inductance of the inductor L1 by which L1 was connected to the upstream coil N1 of the pressure-up transformer T, respectively.
[0028] In addition, as conditions on which this primary equal circuit is materialized, it is required to fill C3>Cload, C2>Cloadx(N2/N1) 2, L0>L1, and Ls. Here, it is L1+Ls=L.
[0029] In the above composition, AC-bias voltage is outputted as follows by the AC-bias power unit concerning this example. That is, in the above-mentioned AC-bias power unit, as shown in drawing 4 , since diodes D1 and D2 are reverse blocking states, while the current iL which flows an inductor L1 maintains the state of 0, in the "mode 0" in which the 1st and 2nd switching elements SW1 and SW2 are [both] OFF states, the voltage Vc of the capacitor Cload which is a load serves as the predetermined value Vc (0). Therefore, the voltage of P points becomes the value which added voltage 1/2Vcc of the 2nd capacitor C2 to the voltage Vc of the capacitor Cload which is a load, i.e., 1/2 Vcc+Vc, (0).
[0030] In the mode 1, next the "mode 1" in which only a predetermined time makes the 2nd switching element SW2 an ON state As shown in drawing 4 (f), the charge accumulated through the 2nd switching element SW2 at the 2nd capacitor C2 flows as current iL. Series resonance operation of the series resonant circuit which consists of leakage inductance Ls of the 2nd capacitor C2, load-carrying capacity Cload, and the pressure-up transformer T, an inductor L1, and the 2nd switching element SW2 is started, and a state changes like a lower formula. Here, it is omega= 1/. It considers as LC and gamma= [V(0)/(1/2Vcc)].
[0031] Then, the current isw2 (t) which flows the 2nd switching element SW2 is isw2(t) =-iL (t), when the current iL (t) which flows Inductor L is taken in the direction shown in the solid line of drawing 2 . = (1 / 2 Vcc+V (0)) - It can express C/L-sinomegat (drawing 4 (b)). Alternating voltage Vc impressed to a load on the other hand (t) Vc(t) =(1 / 2 Vcc+V (0)) cosomegat-1/2Vcc It is set to =[(1+gamma) cosomegat-1] x1/2Vcc.
[0032] If the 2nd switching element SW2 is made into an ON state as it is, a state will change to the dashed line A of drawing 4 (a) like and loss of each part will be disregarded, the free vibration by the series resonant circuit of LC will continue. However, the 2nd switching element SW2 is made to turn off in this example when Vc(t) =0, i.e., the voltage of P points, is set to 1/2Vcc. Namely, time t which makes this 2nd switching element SW2 turn off Vc(t) =[(1+gamma)cosomegat-1] x1/2Vcc = since it is

0, Time t is t=1/omegacos-1{1/(1+gamma)}.
When it becomes, it is set up so that the 2nd switching element SW2 may be made to turn off.
[0033] the mode 2 -- the value of the current isw2 which was flowing Vc at the time of the end in "the mode 1" (t), and the 2nd switching element SW2 in the "mode 2" in which this 2nd switching element SW2 is made to turn off, i.e., the initial value in "the mode 2", -- the above -- Vc(t) =0-iL(t) =isw2 (t) =(1/2Vcc+V(0))
- C/L-sin {omegacos-1[1/(1+gamma)]}
It becomes.
[0034] Moreover, the state of each part is expressed with a lower formula. That is, if the 2nd switching element SW2 is made to turn off, the excitation energy accumulated at an inductor L1 and leakage inductance Ls will return to a power supply Vcc side through diode D1. Therefore, the current iD1 (t) which flows the 1st diode D1 and voltage Vc of a load (t) iD1 (t) = - (1 / 2 Vcc+V (0))
- C/L-sin{omega (t-cos-1 [1/(1+gamma)]})
Vc(t) ={1-(1+gamma) cos[omega (-1 {1/(1+gamma) of t-cos)
It can express]}x1/2Vcc.
[0035] This the "mode 2" continues until the current iD1 which flows the 1st diode D1 is set to 0, as shown in drawing 4 (c). That is, it continues to t=cos -1 {1/(1+gamma)]}, and if the current iD1 which only this time t passes and flows the 1st diode D1 is set to 0, since "the mode 1" is charged in reversed polarity, the voltage Vc of a load (t) will be set to Vc(t) =-V (0). Therefore, the voltage of P points serves as 1 / 2 Vcc-V (0), as shown in drawing 4 (a).
[0036] After the end in in the mode 3, next "the mode 2", if the 1st and 2nd switching elements SW1 and SW2 are set [both] to OFF, as the state, i.e., the voltage of P points, of Vc(t) =-V at the end time in "the mode 2" (0) shows drawing 4 (a), the state of 1 / 2 Vcc-V (0) will be maintained.
[0037] Although it operates after that [mode 4] in the "mode 4" in which only a predetermined time makes the 1st switching element SW1 an ON state, like the "mode 1" in which only a predetermined time makes the 2nd switching element SW2 an ON state fundamentally Since the current which flows through the 1st switching element SW1 from DC power supply Vcc flows in the direction shown in drawing 2 as a solid line, polarity reverses the value and output voltage Vc (t) of Current iL which flow an inductance to the case in "the mode 1." That is, the value of the current iL which flows an inductance should be shown in drawing 4 (f). isw1(t) =iL (t)
= - (1 / 2 Vcc+V (0)) - It becomes C/L-sinomegat. Alternating voltage Vc impressed to a load on the other hand (t) Vc(t) =-(1 / 2 Vcc+V (0)) cosomegat-1/2Vcc It is set to =-[(1+gamma)cosomegat-1] x1/2Vcc.
[0038] If the 1st switching element SW1 is made into an ON state as it is, like the dashed line of B of drawing 4 (a), a state changes, and if loss of each part is disregarded, the free vibration by the series resonant circuit of LC will continue. However, the 1st switching element SW1 is made to turn off in this example when Vc(t) =0, i.e., the voltage of P points, is set to 1/2Vcc. That is, the time t which makes this 1st switching element SW1 turn off is t=1/omegacos-1{1/(1+gamma)} like "the mode 1."
It is alike and is set up.
[0039] the mode 5 -- although this the "mode 5" operates like "the mode 2" fundamentally, polarity reverses the value of the current iL which flows output voltage Vc (t) and an inductance to the case in "the mode 2"
[0040] That is, the value of the current isw1 which was flowing Vc at the time of the end in "the mode 4" (t) and the 1st switching element SW1 in the "mode 5" in which the 1st switching element SW1 of the above is made to turn off, i.e., the initial value in "the mode 5", is Vc(t) =0-iL(t) =isw2 (t) from the above.
=(1/2Vcc+V(0))
- C/L-sin {omegacos-1[1/(1+gamma)]}
It becomes. In addition, the current iD2 (t) which flows the 2nd diode D2, and the voltage Vc of a load (t) are reversed to the case in "the mode 2."
[0041] This the "mode 5" continues until the current iD2 which flows the 2nd diode D2 is set to 0, as

shown in drawing 4 (e). That is, it continues to t=cos -1 {1/(1+gamma)]}, and if the current iD2 which only this time t passes and flows the 2nd diode D2 is set to 0, the voltage Vc of a load (t) will be set to Vc(t) =V (0). Therefore, the voltage of P points serves as 1 / 2 Vcc+V (0), as shown in drawing 4 (a).
[0042] the mode -- six -- again -- this -- " -- the mode -- six -- " -- fundamental -- " -- the mode -- zero -- " -- the same -- operating -- although -- output voltage -- Vc -- (-- t --) -- a value -- " -- the mode -- zero -- " -- it is -- a case -- receiving -- having been reversed -- + -- Vc -- (-- zero --) -- becoming .
[0043] Then, "from the mode 1" to the "mode 6" will be repeated successively.
[0044] Thus, since it operates as mentioned above, the AC-bias power unit concerning the above-mentioned example is the ON time of the 2nd switching element SW2 in "the mode 1", and the ON time of the 1st switching element SW1 in "the mode 4" like the above Ton=(1-/omega) cos-1{1/(1+gamma)]}

By setting up so that it may become, the voltage Vcpp between peaks of the alternating voltage impressed to load-carrying capacity Cload is Vcpp=2V (0) so that clearly from drawing 4 (a).
= It will be given by 2gamma and (1/2) Vcc=gamma-Vcc. namely, the thing for which a control parameter is set to gamma -- ON time Ton=(1-/omega) cos- of the 1st switching element SW1 and the 2nd switching element SW2 -- when referred to as 1 {1/(1+gamma)]}, the voltage Vcpp between peaks of output voltage will be controlled by Vcpp=gamma-Vcc as a primary equivalent of an equal circuit
[0045] Drawing 5 is the graph of the oscilloscope in which the alternating voltage generated according to one example of the AC-bias power unit concerning this example is shown.
[0046] Since in-series LC resonance circuits also including a capacitive load are constituted from this example, conventionally Since the capacitive load itself constitutes a part of in-series LC resonance circuit to power having been consumed by movement of the charge to a load while repeating accumulation and discharge of a charge for a load, Since it becomes only the resistance component of an in-series LC resonance circuit and stops being theoretically dependent on the electrostatic capacity of a load, efficient-ization of the power consumed is attained by mitigating a power loss.
[0047] Drawing 8 or drawing 10 shows the modification of this example.
[0048] In the modification of drawing 8 , capacitors C1 and C2 are not formed in the upstream coil N1 of the pressure-up transformer T, instead two DC power supplies Vcc and Vcc are formed. Moreover, in the modification of drawing 9 , the partial pressure resistance R1 and R2 for generating the energization voltage of the first energization circuit is connected to the upstream coil N1 of the pressure-up transformer T in parallel with DC power supply Vcc instead of the capacitor C1. Furthermore, while the upstream coil N1 of the pressure-up transformer T is divided into two and the plus side of DC power supply Vcc is connected to the middle terminal of the upstream coil N1 concerned in the modification of drawing 10 The minus side of DC power supply Vcc is connected to the ends child of the upstream coil N1 concerned through the 1st of parallel connection, the 1st as 2nd switching element SW1 and SW2, the 2nd transistor and the 1st, and 2nd diodes.
[0049] If second example drawing 6 shows the second example of this invention and the same sign is attached and explained to the same portion as the aforementioned example, in this example, stabilization of output voltage is possible for it.
[0050] That is, by stabilizing the supply voltage Vcc impressed to the upstream coil N1 of a pressure-up transformer, in order to stabilize the output voltage of the above-mentioned AC-bias power unit, the detection coil for detecting output voltage to the method and pressure-up transformer which stabilize output voltage indirectly is formed, and the method of controlling the supply voltage Vcc impressed to the upstream coil N1 of a pressure-up transformer etc. is used so that the output of this detection coil may be stable.
[0051] However, in both the cases of the above-mentioned former and the latter, since it has combination of a transformer, and the influence of the impedance of a transformer coil, it has the trouble that output voltage cannot be stabilized to change or variation of a load. Moreover, the trouble that in both the cases of the above-mentioned former and the latter it was required to make big electrostatic capacity of an alternating current bypass capacitor in order to change the variation in the alternating current component which appears in an output and to stop this under the influence of the variation in the

electrostatic capacity of an alternating current bypass capacitor, temperature change, etc., if the alternating current bypass capacitor which makes direct-current bias voltage bypass an alternating current component is connected in parallel in order to make direct-current bias voltage **** on AC-bias voltage was.
[0052] Then, in this example, while being able to stabilize output voltage to change and variation of a load, it aims at offering the AC-bias power unit which can prevent the variation in the alternating current component which appears in an output under the influence of the variation in the electrostatic capacity of an alternating current bypass capacitor, temperature change, etc.
[0053] Therefore, it has the capacitor by which the end was connected to the alternating current high-pressure output side, and the other end was connected to the current rectifier circuit, and the current which flows this capacitor is rectified by the aforementioned rectifier circuit, and it consists of this example so that the output voltage of an alternating current high voltage power supply may be controlled by this rectification output.
[0054] That is, in this example, as shown in drawing 6 , the capacitor C5 and diode D5 of a series connection are connected to the secondary coil N2 of a pressure-up transformer in parallel. Moreover, while the output voltage detected through diode D6 is outputted to the node of such capacitors C5 and diodes D5, resistance R1 and the capacitor C6 are connected to the detection output side of diode D6 in parallel.
[0055] therefore, the influence of the variation in the electrostatic capacity of the bypass capacitor which it will be given by Vdep=freq-C1 and Vpp-R1 if the output voltage detection voltage Vdep is Vdep<<Vpp, and will be connected to combination of Transformer T, the influence of the impedance of a transformer coil, or the secondary coil N2 of the pressure-up transformer T if the precision of the frequency freq of output voltage is good -- nothing -- output voltage -- being detectable .
[0056] If the precision of the frequency freq of output voltage is good in this example, thus, combination of Transformer T and influence of the impedance of a transformer coil, Or since direct-output voltage is detectable without the influence of the variation in the electrostatic capacity of the bypass capacitor connected to the secondary coil N2 of the pressure-up transformer T Precision can improve output voltage a constant pressure control by controlling the timing which turns on and off the above 1st and the 2nd switching element SW1 and SW2 by the aforementioned control circuit 20 based on this detected output voltage.
[0057] Since other composition and operations are the same as that of the first example of the above, the explanation is omitted.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is the circuit diagram showing one example of the AC-bias power unit concerning this invention.
[Drawing 2] Drawing 2 is the representative circuit schematic of the circuit shown in drawing 1 .
[Drawing 3] Drawing 3 is the block diagram showing the color electrophotography copying machine which can apply the AC-bias power unit concerning this invention.
[Drawing 4] Drawing 4 (a) - (f) is a graph which shows operation of the AC-bias power unit of drawing 1 , respectively.
[Drawing 5] Drawing 5 is the wave form chart showing the output wave of the circuit shown in drawing 1 .
[Drawing 6] Drawing 6 is the circuit diagram showing other examples of this invention.
[Drawing 7] Drawing 7 is the circuit diagram showing the conventional AC-bias power unit.
[Drawing 8] Drawing 8 is the circuit diagram showing other modifications of the AC-bias power unit concerning this invention.
[Drawing 9] Drawing 9 is the circuit diagram showing other modifications of the AC-bias power unit concerning this invention.
[Drawing 10] Drawing 10 is the circuit diagram showing other modifications of the AC-bias power unit concerning this invention.
[Description of Notations]
T A pressure-up transformer, SW1 The 1st switching element, SW2 The 2nd switching element, D1 The 1st diode, D2 The 2nd diode, L1 Inductance

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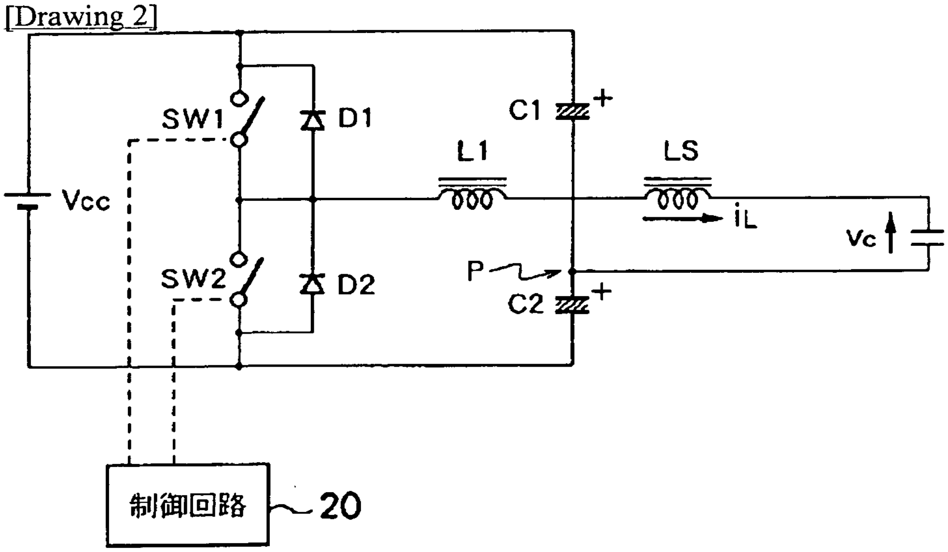
[Translation done.]

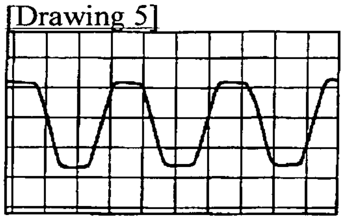
* NOTICES *

DRAWINGS

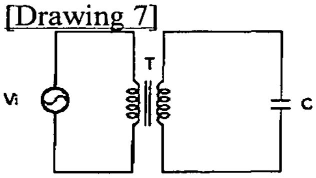
[Drawing 2]



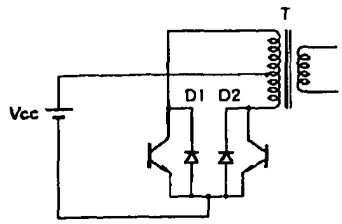
[Drawing 5]



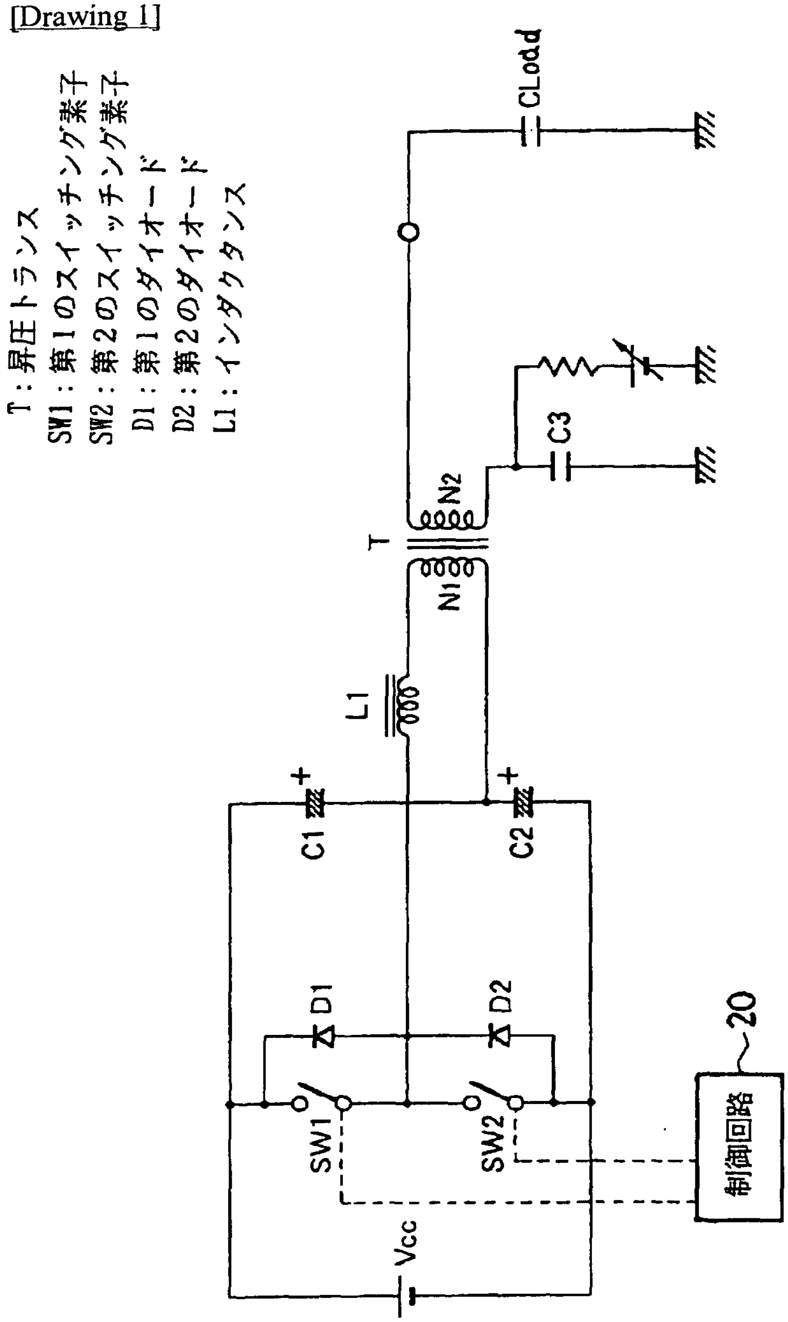
[Drawing 7]



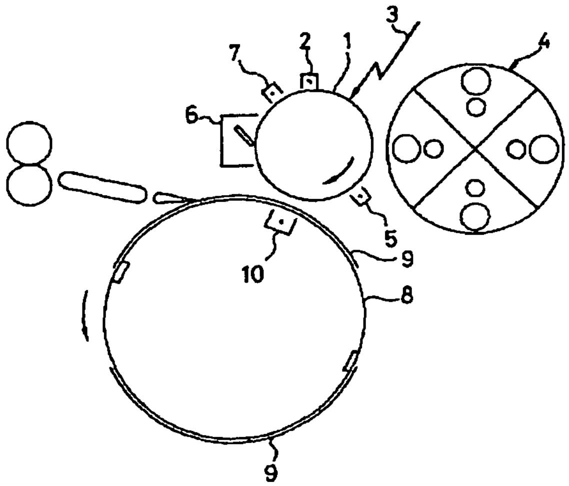
[Drawing 10]



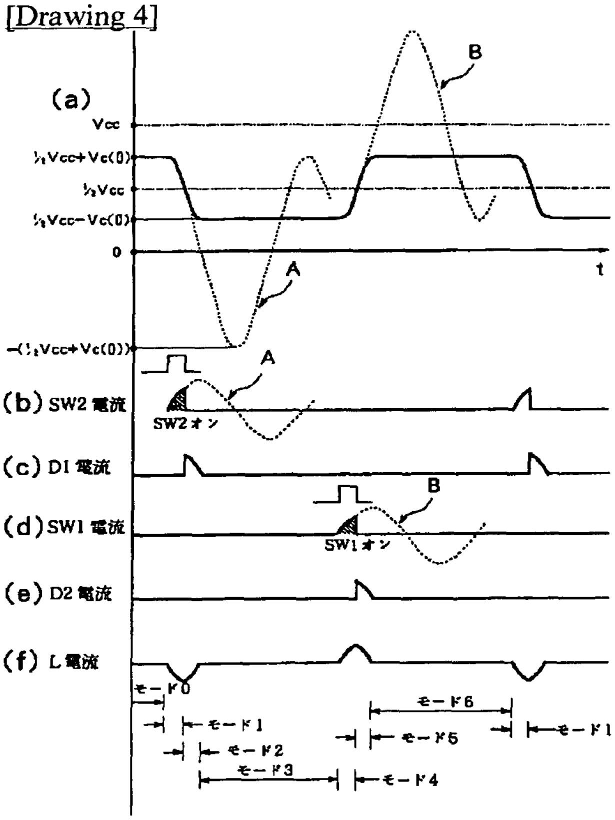
[Drawing 1]



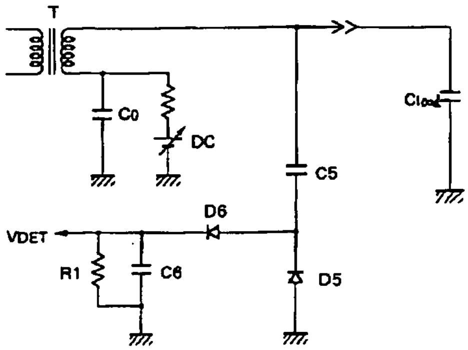
[Drawing 3]



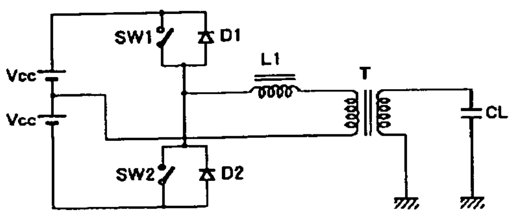
[Drawing 4]



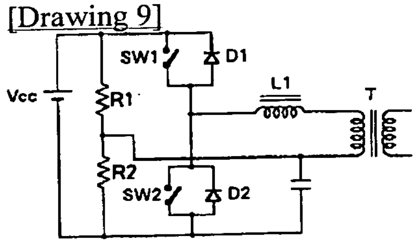
[Drawing 6]



[Drawing 8]

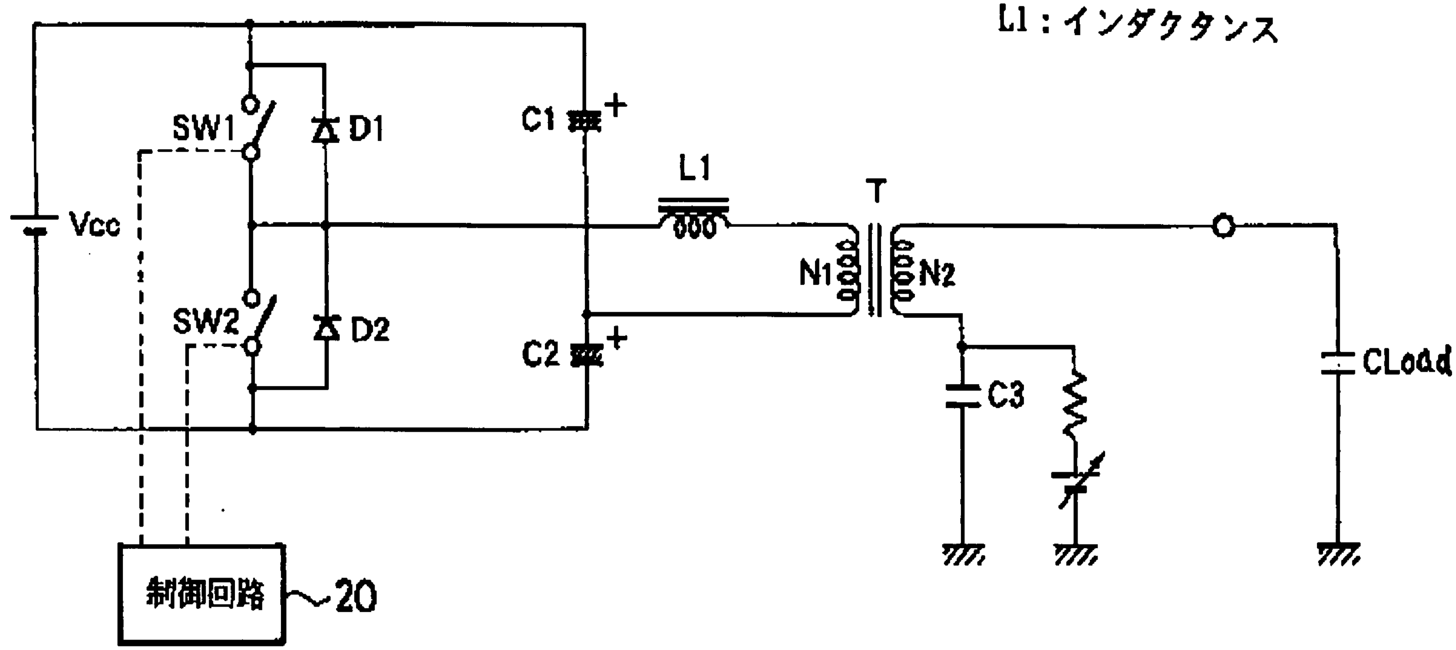


[Drawing 9]



[Translation done.]

T：昇圧トランス
SW1：第1のスイッチング素子
SW2：第2のスイッチング素子
D1：第1のダイオード
D2：第2のダイオード
L1：インダクタンス



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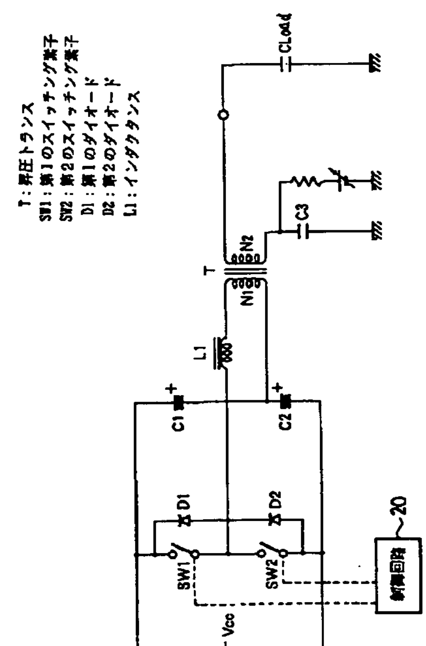
(54)【発明の名称】　交流バイアス電源装置

(57)【要約】

【目的】　電力損失を軽減することにより高効率化が可能な交流バイアス電源装置を提供することを目的とする。

【構成】　容量性の負荷に直列に接続され、当該容量性の負荷とともにＬＣ直列共振回路を構成するインダクタンスと、前記ＬＣ直列共振回路を正方向に付勢する付勢時間制御可能な第１のスイッチング回路と、前記第１のスイッチング回路による付勢終了後の直列共振エネルギを回生する第１のダイオードとを設けた第１の付勢回路と、前記ＬＣ直列共振回路を負方向に付勢する付勢時間制御可能な第２のスイッチング回路と、前記第２のスイッチング回路による付勢終了後の直列共振エネルギを回生する第２のダイオードとを設けた第２の付勢回路とを具備し、前記第１及び第２の付勢回路の付勢時間を制御することにより出力電圧を制御するように構成した。



1

【特許請求の範囲】

【請求項1】　容量性の負荷に交流のバイアス電圧を供給する交流バイアス電源装置において、前記容量性の負荷に直列に接続され、当該容量性の負荷とともにＬＣ直列共振回路を構成するインダクタンスと、前記ＬＣ直列共振回路を正方向に付勢する付勢時間制御可能な第１のスイッチング回路と、前記第１のスイッチング回路による付勢終了後の直列共振エネルギを回生する第１のダイオードとを設けた第１の付勢回路と、前記ＬＣ直列共振回路を負方向に付勢する付勢時間制御可能な第２のスイッチング回路と、前記第２のスイッチング回路による付勢終了後の直列共振エネルギを回生する第２のダイオードとを設けた第２の付勢回路とを具備し、前記第１及び第２の付勢回路の付勢時間を制御することにより出力電圧を制御するようにしたことを特徴とする交流バイアス電源装置。

【請求項2】　前記容量性の負荷と第１及び第２の付勢回路との間に、昇圧トランスを配置したことを特徴とする請求項第１項記載の交流バイアス電源装置。

【請求項3】　前記インダクタンスが昇圧トランスの漏れインダクタンスからなることを特徴とする請求項第２項記載の交流バイアス電源装置。

【請求項4】　交流高圧出力側に一端を接続され、他端を電流整流回路に接続されたコンデンサを有し、このコンデンサを流れる電流を前記整流回路で整流し、この整流出力で交流高圧電源の出力電圧を制御するように構成したことを特徴とする交流バイアス電源装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、電子写真複写機やプリンタ等の電子写真応用装置に使用される現像器などに交流バイアスを印加するための交流バイアス電源装置に関するものである。

【０００２】

【従来の技術】最近、上記電子写真複写機等には、高画質化に加えてカラー化・高速化・小型化が強く要求されてきているとともに、記録用紙として普通紙以外にもＯＨＰシート（オーバーヘッドプロジェクタ用の透明な合成樹脂製シート）等に複写可能な機種が求められている。これらの要求に答え得るカラー電子写真複写機としては、感光体ドラムの近傍に転写ドラムを配設し、感光体ドラム上に形成されたトナー像を、転写ドラムの周囲に保持された記録用紙上に順次転写して、記録用紙上に４色のトナー像を重ねた後、これらのトナー像を記録用紙上に定着することによってカラー画像の複写を行うように構成したものがある。

【０００３】このカラー電子写真複写機は、感光体ドラムの一側にロータリー式の４色の現像器を配設し、これらの現像器を回転させることによって、感光体ドラム上に順次形成される静電潜像をシアン・マゼンタ・イエロー・ブラック等の４色のトナー像により順次現像する。また、上記転写ドラムは、その外周面を合成樹脂製のフィルムによって形成することにより、この転写ドラムの外周面に記録用紙を静電的に保持するようになっている。さらに、上記転写ドラムの内部には、感光体ドラム上に形成されたトナー像を、転写ドラムの周囲に保持された記録用紙上に静電的に転写するための転写コロトロンを配設するように構成されている。

2

【０００４】従来、この種のカラー電子写真複写機等に使用される現像器などに交流のバイアス電圧を印加するための交流バイアス電源装置としては、図７に示すようなものがある。これは、昇圧トランスＴの一次側巻線Ｎ１に印加される直流電圧Ｖｉをオンオフ制御することによって、昇圧トランスＴの二次側巻線Ｎ２に所定の交流電圧を誘起し、この交流電圧をバイアスとして負荷である現像器などに出力するように構成されている。ここで、負荷としての現像器は、既知のように、金属製の円筒からなる現像スリーブの外周にトナーを保持するとともに、現像スリーブに直流電圧を昼重させた交流バイアス電圧を印加して、感光体ドラム上の静電潜像を現像するものである。このように、現像器は、感光体ドラム等の導体と対向配置される金属製円筒からなる現像スリーブを備えているため、負荷としては、コンデンサと同様に作用する容量性の負荷となっている。

【０００５】また、上記交流バイアス電源装置としては、特開昭５７－１２４７５７号公報に示すようなものも既に提案されている。この装置は、記録体上に形成された静電潜像を現像器にバイアス電圧を印加してトナー現像し静電記録を行う静電記録装置の現像バイアス装置において、正弦波発振回路から得られる正弦波電圧を増幅回路で増幅し、この増幅された電圧を昇圧トランスで昇圧した交流電圧を前記バイアス電圧とし、昇圧トランスの出力を検出して前記増幅回路の利得を調整する自動利得調整回路により増幅回路の出力を一定にするように構成したものである。

【０００６】

【発明が解決しようとする課題】しかし、上記従来技術の場合には、次のような問題点を有している。すなわち、上記図７に示す交流バイアス電源装置及び提案に係る装置の場合には、入力電圧Ｖｉを昇圧トランスで昇圧した後、この昇圧された交流電圧を交流バイアス電圧として負荷としての現像器等に出力するように構成されている。そのため、上記装置の場合には、現像器等の負荷が容量性の負荷であり、この容量性の負荷を充放電するためのエネルギーロスが熱という形で発生し、効率が悪いという問題点があった。特に、容量性負荷としての現像器の静電容量が大きく、しかも交流バイアス電圧の周波数が高い場合には、負荷のインピーダンスが小さくなるため、エネルギーロスの問題が顕著となる。

【０００７】

3

【課題を解決するための手段】そこで、この発明は、上記従来技術の問題点を解決するためになされたもので、その目的とするところは、電力損失を軽減することにより高効率化が可能な交流バイアス電源装置を提供することにある。

【0008】すなわち、請求項第1項に記載の発明は、容量性の負荷に交流のバイアス電圧を供給する交流バイアス電源装置において、前記容量性の負荷に直列に接続され、当該容量性の負荷とともにLC直列共振回路を構成するインダクタンスと、前記LC直列共振回路を正方向に付勢する付勢時間制御可能な第1のスイッチング回路と、前記第1のスイッチング回路による付勢終了後の直列共振エネルギを回生する第1のダイオードとを設けた第1の付勢回路と、前記LC直列共振回路を負方向に付勢する付勢時間制御可能な第2のスイッチング回路と、前記第2のスイッチング回路による付勢終了後の直列共振エネルギを回生する第2のダイオードとを設けた第2の付勢回路とを具備し、前記第1及び第2の付勢回路の付勢時間を制御することにより出力電圧を制御するように構成されている。

【0009】前記容量性の負荷と第1及び第2の付勢回路との間には、例えば、昇圧トランスを配置することができる。

【0010】また、前記インダクタンスとしては、例えば、昇圧トランスの漏れインダクタンスからなるものを用いることができる。

【0011】さらに、請求項第4項に記載の発明は、交流高圧出力側に一端を接続され、他端を電流整流回路に接続されたコンデンサを有し、このコンデンサを流れる電流を前記整流回路で整流し、この整流出力で交流高圧電源の出力電圧を制御するように構成されている。

【0012】上記第1及び第2のスイッチング素子SW1，SW2としては、例えば、トランジスタやFET等のスイッチング素子を用いることができる。

【0013】また、上記第1のダイオード及び第2のダイオードとしては、例えば、FETに内蔵された寄生ダイオードを用いることができるが、これらの第1のダイオード及び第2のダイオードとしては、通常のダイオード素子そのものを用いても良いことは勿論である。

【0014】

【作用】この発明においては、請求項第1項乃至第3項に記載の発明は同様に、容量性の負荷とともに直列LC共振回路を構成するインダクタを設けるように構成されている。そのため、容量性の負荷をも含めてLC直列共振回路を構成するようになっているため、従来は、電源から供給される電圧を昇圧トランスによって昇圧して負荷に供給する際、負荷への電荷の蓄積及び放出を繰り返す間に、負荷への電荷の移動により電力が消費されていたのに対し、容量性の負荷自体がLC直列共振回路の一部を構成するため、消費される電力は、LC直列共振回路の抵抗成分のみとなり、負荷の静電容量には理論的に依存しなくなるため、電力損失を軽減することにより高効率化が可能となる。

4

【0015】

【実施例】以下にこの発明を図示の実施例に基づいて説明する。

【0016】図3はこの発明に係る交流バイアス電源装置を適用し得るカラー電子写真複写機を示すものである。

【0017】図において、1は感光体ドラムであり、この感光体ドラム1の周囲には、感光体ドラム1の表面を所定の電位に一様に帯電する一次帯電器2と、この一様に帯電された感光体ドラム1の表面に画像を露光して静電潜像を形成するための画像露光3と、感光体ドラム1の表面に形成された静電潜像を現像するためのシアン・マゼンタ・イエロー・ブラック等の4色のトナー像により現像するロータリー方式の現像器4と、感光体ドラム1の表面に形成されたトナー像の電位及び感光体ドラムの表面電位を調整する転写前コロトロン5と、感光体ドラム1表面の残留トナー等を清掃するクリーナー6と、トナー像が転写された後の感光体ドラム1の残留電荷を消去する除電用コロトロン7等が配設されている。

【0018】また、上記感光体ドラム1の近傍には、転写ドラム8が配設されており、感光体ドラム1上に形成されたトナー像を、転写ドラム8の周囲に保持された記録用紙9上に順次転写するようになっている。上記転写ドラム8は、その外周面が透明な合成樹脂製のフィルムによって形成されており、この転写ドラム8の外周面に記録用紙9を静電的に保持するようになっている。さらに、上記転写ドラム8の内部には、感光体ドラム1上に形成されたトナー像を、転写ドラム8の周囲に保持された記録用紙9上に静電的に転写するための転写コロトロン10が配設されている。

【0019】ところで、上記カラー電子写真複写機の現像器等の容量性負荷に交流のバイアス電圧を供給する交流バイアス電源装置は、前記容量性の負荷に直列に接続され、当該容量性の負荷とともにLC直列共振回路を構成するインダクタンスと、前記LC直列共振回路を正方向に付勢する付勢時間制御可能な第1のスイッチング回路と、前記第1のスイッチング回路による付勢終了後の直列共振エネルギを回生する第1のダイオードとを設けた第1の付勢回路と、前記LC直列共振回路を負方向に付勢する付勢時間制御可能な第2のスイッチング回路と、前記第2のスイッチング回路による付勢終了後の直列共振エネルギを回生する第2のダイオードとを設けた第2の付勢回路とを具備し、前記第1及び第2の付勢回路の付勢時間を制御することにより出力電圧を制御するように構成されている。

【0020】図1はこの発明に係る交流バイアス電源装置の一実施例を示すものである。

【0021】図において、Tは昇圧トランスを示すものであり、この昇圧トランスTの一次側巻線N1には、所定電圧の直流電源Vｃｃが印加されるようになっている。また、上記昇圧トランスTの一次側巻線N1には、第1のスイッチング素子SW1が直列に接続されているとともに、当該第1のスイッチング素子SW1よりも負荷側には、第2のスイッチング素子SW2が並列に接続されている。また、上記第1のスイッチング素子SW1及び第2のスイッチング素子SW2には、逆向きの第1のダイオードD1及び第2のダイオードD2がそれぞれ並列に接続されている。さらに、上記第2のスイッチング素子SW2よりも負荷側には、容量性の負荷とともに直列LC共振回路を構成するインダクタが、一次側巻線N1の正極側に直列に接続されている。また、上記直流電源Vｃｃの正極には、大容量の第1のコンデンサC1が一次側巻線N1の負極端子と間に接続されているとともに、当該一次側巻線N1の負極端子には、大容量の第2のコンデンサC2が並列に接続されている。

【0022】また、上記昇圧トランスTの二次側巻線N2には、負荷としての現像器が接続されており、この負荷としての現像器は、前述したように、感光体ドラム1等の導体と対向配置される金属製円筒からなる現像スリーブを備えているため、負荷としては、コンデンサと同様に作用する容量性の負荷となっている。

【0023】さらに、上記昇圧トランスTの二次側巻線N2には、現像器に直流バイアス電圧を印加するための直流バイアス電源と、交流バイパスコンデンサが並列に接続されている。

【0024】また、上記第1のスイッチング素子SW1及び第2のスイッチング素子SW2は、制御回路によって所定のタイミングでオンオフ制御されるように構成されている。

【0025】なお、上記第1及び第2のスイッチング素子SW1，SW2としては、トランジスタやFET等のスイッチング素子を用いることができる。

【0026】図2はこの実施例に係る交流バイアス電源装置の1次の等価回路を示すものである。

【0027】図において、L1は昇圧トランスTの一次側巻線N1に接続されたインダクタL1のインダクタンスを、L0は昇圧トランスTの励磁インダクタンスを、Lｓは一次側巻線N1及び二次側巻線N2の漏れインダクタンス、Cｌｏａｄは負荷である現像器の静電容量をそれぞれ示している。

【0028】なお、この1次の等価回路が成立する条件としては、C3＞Cｌｏａｄ、C2＞Cｌｏａｄ×（N2／N1）^{2}、L0＞L1，Lｓを満たすことが必要である。ここで、L1＋Lｓ＝Lとなっている。

【0029】以上の構成において、この実施例に係る交流バイアス電源装置では、次のようにして交流バイアス電圧を出力するようになっている。すなわち、上記交流バイアス電源装置では、図4に示すように、第1及び第2のスイッチング素子SW1，SW2が共にオフ状態である”モード0”において、ダイオードD1，D2は逆阻止状態であるため、インダクタL1を流れる電流ｉL は、0の状態を維持するとともに、負荷であるコンデンサCｌｏａｄの電圧Vｃは、所定の値Vｃ（0）となる。そのため、P点の電圧は、負荷であるコンデンサCｌｏａｄの電圧Vｃに、第2のコンデンサC2の電圧1／2Vｃｃを加えた値、すなわち1／2Vｃｃ＋Vｃ（0）となる。

【0030】モード1

次に、第2のスイッチング素子SW2を所定時間だけオン状態とする”モード1”においては、図4（f）に示すように、第2のスイッチング素子SW2を介して第2のコンデンサC2に蓄積された電荷が電流ｉLとして流れ、第2のコンデンサC2、負荷容量Cｌｏａｄ、昇圧トランスTの漏れインダクタンスLｓ、インダクタL1及び第2のスイッチング素子SW2からなる直列共振回路の直列共振動作が開始され、下式のように状態は変化する。ここで、ω＝1／　LC、γ＝〔V（0）／（1／2Vｃｃ）〕とする。

【0031】すると、第2のスイッチング素子SW2を流れる電流ｉｓｗ2（ｔ）は、インダクタLを流れる電流ｉL（ｔ）を図2の実線に示す方向にとると、

ｉｓｗ2（ｔ）＝－ｉL（ｔ）
＝（1／2Vｃｃ＋V（0））・　C／L・ｓｉｎωｔ

と表すことができる（図4（b））。一方、負荷に印加される交流電圧Vｃ（ｔ）は、

Vｃ（ｔ）＝（1／2Vｃｃ＋V（0））ｃｏｓωｔ－1／2Vｃｃ
　　　＝〔（1＋γ）ｃｏｓωｔ－1〕×1／2Vｃｃ

となる。

【0032】もし、第2のスイッチング素子SW2をそのままオン状態とすると、図4（a）の破線Aにように状態は変化し、各部の損失を無視すればLCの直列共振回路による自由振動が続く。しかし、この実施例では、第2のスイッチング素子SW2をVｃ（ｔ）＝0、即ちP点の電圧が1／2Vｃｃとなった時点でオフさせる。すなわち、この第2のスイッチング素子SW2をオフさせる時間ｔは、

Vｃ（ｔ）＝〔（1＋γ）ｃｏｓωｔ－1〕×1／2Vｃｃ
　　　＝0

であるから、時間ｔが、

ｔ＝1／ωｃｏｓ$^{-1}$｛1／（1＋γ）｝

となった時点で第2のスイッチング素子SW2をオフさせるように設定されている。

【0033】モード2
この第2のスイッチング素子SW2をオフさせる”モード2”では、”モード1”の終了時のVc（t）及び第2のスイッチング素子SW2を流れていた電流isw2の値、即ち”モード2”の初期値は、上記より、

$Vc(t)=0$

$-iL(t)=isw2(t)$

$=(1/2Vcc+V(0))$

$\cdot\sqrt{C/L}\cdot\sin\{\omega\cos^{-1}〔1/(1+\gamma)〕\}$

となる。

【0034】また、各部の状態は、下式で表される。すなわち、第2のスイッチング素子SW2をオフさせると、インダクタL1及び漏れインダクタンスLsに蓄積された励磁エネルギが、ダイオードD1を介して電源Vcc側に帰還される。そのため、第1のダイオードD1を流れる電流iD1（t）及び負荷の電圧Vc（t）は、

$$iD1(t)=-(1/2Vcc+V(0))\cdot\sqrt{C/L}\cdot\sin\{\omega(t-\cos^{-1}〔1/(1+\gamma)〕\}$$

$$Vc(t)=\{1-(1+\gamma)\cos〔\omega(t-\cos^{-1}\{1/(1+\gamma)〕\}\times1/2Vcc$$

と表すことができる。

【0035】この”モード2”は、図4（c）に示すように、第1のダイオードD1を流れる電流iD1が0になるまで続く。即ち、$t=\cos^{-1}\{1/(1+\gamma)〕\}$まで続き、この時間tだけ経過して第1のダイオードD1を流れる電流iD1が0となると、負荷の電圧Vc（t）は、”モード1”とは逆極性に帯電されるため、Vc（t）＝－V（0）となる。したがって、P点の電圧は、図4（a）に示すように、1／2Vcc－V（0）となる。

【0036】モード3
次に、”モード2”の終了後、第1及び第2のスイッチング素子SW1，SW2を共にオフとすると、”モード2”の終了時点のVc（t）＝－V（0）の状態すなわちP点の電圧が、図4（a）に示すように、1／2Vcc－V（0）の状態が維持される。

【0037】モード4
その後、第1のスイッチング素子SW1を所定時間だけオン状態とする”モード4”においては、基本的に第2のスイッチング素子SW2を所定時間だけオン状態とする”モード1”と同様に動作するが、直流電源Vccから第1のスイッチング素子SW1を介して流れる電流が、図2に実線で示す方向に流れるため、インダクタンスを流れる電流iLの値及び出力電圧Vc（t）は、”モード1”の場合に対して極性が反転する。すなわち、インダクタンスを流れる電流iLの値は、図4（f）に示すように、

$$isw1(t)=iL(t)=-(1/2Vcc+V(0))\cdot\sqrt{C/L}\cdot\sin\omega t$$

となる。一方、負荷に印加される交流電圧Vc（t）は、

$$Vc(t)=-(1/2Vcc+V(0))\cos\omega t-1/2Vcc=-〔(1+\gamma)\cos\omega t-1〕\times1/2Vcc$$

となる。

【0038】もし、第1のスイッチング素子SW1をそのままオン状態とすると、図4（a）のBの破線のように状態は変化し、各部の損失を無視すればLCの直列共振回路による自由振動が続く。しかし、この実施例では、第1のスイッチング素子SW1をVc（t）＝0、即ちP点の電圧が1／2Vccとなった時点でオフさせる。すなわち、この第1のスイッチング素子SW1をオフさせる時間tは、”モード1”と同様、

$t=1/\omega\cos^{-1}\{1/(1+\gamma)\}$

に設定されている。

【0039】モード5
この”モード5”は、基本的に”モード2”と同様に動作するが、出力電圧Vc（t）及びインダクタンスを流れる電流iLの値は、”モード2”の場合に対して極性が反転する。

【0040】すなわち、上記第1のスイッチング素子SW1をオフさせる”モード5”では、”モード4”の終了時のVc（t）及び第1のスイッチング素子SW1を流れていた電流isw1の値、即ち”モード5”の初期値は、上記より、

$Vc(t)=0$

$-iL(t)=isw2(t)$

$=(1/2Vcc+V(0))$

$\cdot\sqrt{C/L}\cdot\sin\{\omega\cos^{-1}〔1/(1+\gamma)〕\}$

となる。その他、第2のダイオードD2を流れる電流iD2（t）及び負荷の電圧Vc（t）は、”モード2”の場合に対して反転する。

【0041】この”モード5”は、図4（e）に示すように、第2のダイオードD2を流れる電流iD2が0になるまで続く。即ち、$t=\cos^{-1}\{1/(1+\gamma)〕\}$まで続き、この時間tだけ経過して第2のダイオードD2を流れる電流iD2が0となると、負荷の電圧Vc（t）は、Vc（t）＝V（0）となる。したがって、P点の電圧は、図4（a）に示すように、1／2Vcc＋V（0）となる。

【0042】モード6
また、この”モード6”は、基本的に”モード0”と同様に動作するが、出力電圧Vc（t）の値が”モード0”の場合に対して反転した＋Vc（0）となる。

【0043】その後、”モード1”から”モード6”までを順次繰り返すことになる。

【0044】このように、上記実施例に係る交流バイアス電源装置は、上記のように動作するので、”モード1”の第2のスイッチング素子SW2のオン時間と”モード4”の第1のスイッチング素子SW1のオン時間を、上記の如く、

$Ton=(1/\omega)\cos^{-1}\{1/(1+\gamma)\}\}$

となるように設定することによって、負荷容量Cloadに印加される交流電圧のピーク間電圧Vcppは、図4（a）から明らかなように、

$Vcpp=2V(0)$

$=2\gamma\cdot(1/2)Vcc$

$=\gamma\cdot Vcc$

によって与えられることになる。即ち、制御パラメータをγとすることにより、第1のスイッチング素子SW1及び第2のスイッチング素子SW2のオン時間$Ton=(1/\omega)\cos^{-1}\{1/(1+\gamma)\}\}$としたとき、出力電圧のピーク間電圧Vcppは、等価回路の1次等価量として

$Vcpp=\gamma\cdot Vcc$

で制御されることになる。

【0045】図5はこの実施例に係る交流バイアス電源装置の一実施例によって発生された交流電圧を示すオシロスコープのグラフである。

【0046】この実施例では、容量性の負荷をも含めて直列LC共振回路を構成するようになっているため、従来は、負荷への電荷の蓄積及び放出を繰り返す間に、負荷への電荷の移動により電力が消費されていたのに対し、容量性の負荷自体が直列LC共振回路の一部を構成するため、消費される電力は、直列LC共振回路の抵抗成分のみとなり、負荷の静電容量には理論的に依存しなくなるため、電力損失を軽減することにより高効率化が可能となる。

【0047】図8乃至図10はこの実施例の変形例を示すものである。

【0048】図8の変形例では、昇圧トランスTの一次側巻線N1にコンデンサC1、C2が設けられておらず、その代わりに直流電源Vcc，Vccが2つ設けられている。また、図9の変形例では、昇圧トランスTの一次側巻線N1にコンデンサC1の代わりに、第一の付勢回路の付勢電圧を発生させるための分圧抵抗R1，R2が直流電源Vccに並列に接続されている。さらに、図10の変形例では、昇圧トランスTの一次側巻線N1が2つに分割されており、当該一次側巻線N1の中間端子に直流電源Vccのプラス側が接続されているとともに、当該一次側巻線N1の両端子には、直流電源Vccのマイナス側が並列接続の第1及び第2のスイッチング素子SW1、SW2としての第1及び第2のトランジスタと第1及び第2のダイオードを介して接続されている。

【0049】第二実施例
図6はこの発明の第二実施例を示すものであり、前記実施例と同一の部分には同一の符号を付して説明すると、この実施例では、出力電圧の安定化が可能となっている。

【0050】すなわち、上記交流バイアス電源装置の出力電圧を安定化させるためには、昇圧トランスの一次側巻線N1に印加される電源電圧Vccを安定化することにより、出力電圧を間接的に安定化する方法、昇圧トランスに出力電圧を検出するための検出巻線を設け、この検出巻線の出力が安定化するように、昇圧トランスの一次側巻線N1に印加される電源電圧Vccを制御する方法等が用いられる。

【0051】しかし、上記前者及び後者の場合には、共にトランスの結合やトランス巻線のインピーダンスの影響があるため、負荷の変動やバラツキに対して出力電圧を安定化することができないという問題点を有している。また、上記前者及び後者の場合には、共に交流バイアス電圧に直流バイアス電圧を畳重させるため、直流バイアス電圧に交流成分をバイパスさせる交流バイパスコンデンサを並列に接続すると、交流バイパスコンデンサの静電容量のバラツキや温度変動等の影響によって出力に現れる交流成分のバラツキが変動し、これを抑えるためには、交流バイパスコンデンサの静電容量を大きなものとすることが必要であるという問題点があった。

【0052】そこで、この実施例では、負荷の変動やバラツキに対して出力電圧を安定化することができるとともに、交流バイパスコンデンサの静電容量のバラツキや温度変動等の影響によって出力に現れる交流成分のバラツキを防止可能な交流バイアス電源装置を提供することを目的とする。

【0053】そのため、この実施例では、交流高圧出力側に一端を接続され、他端を電流整流回路に接続されたコンデンサを有し、このコンデンサを流れる電流を前記整流回路で整流し、この整流出力で交流高圧電源の出力電圧を制御するように構成されている。

【0054】すなわち、この実施例では、図6に示すように、昇圧トランスの二次側巻線N2に直列接続のコンデンサC5及びダイオードD5が、並列に接続されている。また、これらのコンデンサC5とダイオードD5との接続点には、ダイオードD6を介して検出された出力電圧が出力されるようになっているとともに、ダイオードD6の検出出力側には、抵抗R1及びコンデンサC6が並列に接続されている。

【0055】そのため、出力電圧検出電圧Vdepは、

Ｖｄｅｐ≪Ｖｐｐであれば、
Ｖｄｅｐ＝ｆｒｅｑ・Ｃ１・Ｖｐｐ・Ｒ１
で与えられ、出力電圧の周波数ｆｒｅｑの精度が良ければ、トランスＴの結合やトランス巻線のインピーダンスの影響，あるいは、昇圧トランスＴの二次側巻線Ｎ２に接続されるバイパスコンデンサの静電容量のバラツキの影響なしに出力電圧を検出できる。

【００５６】このように、この実施例では、出力電圧の周波数ｆｒｅｑの精度が良ければ、トランスＴの結合やトランス巻線のインピーダンスの影響，あるいは、昇圧トランスＴの二次側巻線Ｎ２に接続されるバイパスコンデンサの静電容量のバラツキの影響なしに直接出力電圧を検出できるので、この検出された出力電圧に基づいて前記制御回路２０によって前記第１及び第２のスイッチング素子ＳＷ１、ＳＷ２をオンオフするタイミングを制御することにより、出力電圧を精度良く定圧制御することができる。

【００５７】その他の構成及び作用は前記第一の実施例と同様であるので、その説明を省略する。

【００５８】

【発明の効果】この発明は、以上の構成及び作用よりなるもので、電力損失を軽減することにより高効率化が可能な交流バイアス電源装置を提供することができる。

【図面の簡単な説明】

【図１】　図１はこの発明に係る交流バイアス電源装置の一実施例を示す回路図である。

【図２】　図２は図１に示す回路の等価回路図である。

【図３】　図３はこの発明に係る交流バイアス電源装置を適用し得るカラー電子写真複写機を示す構成図である。

【図４】　図４（ａ）～（ｆ）は図１の交流バイアス電源装置の動作をそれぞれ示すグラフである。

【図５】　図５は図１に示す回路の出力波形を示す波形図である。

【図６】　図６はこの発明の他の実施例を示す回路図である。

【図７】　図７は従来の交流バイアス電源装置を示す回路図である。

【図８】　図８はこの発明に係る交流バイアス電源装置の他の変形例を示す回路図である。

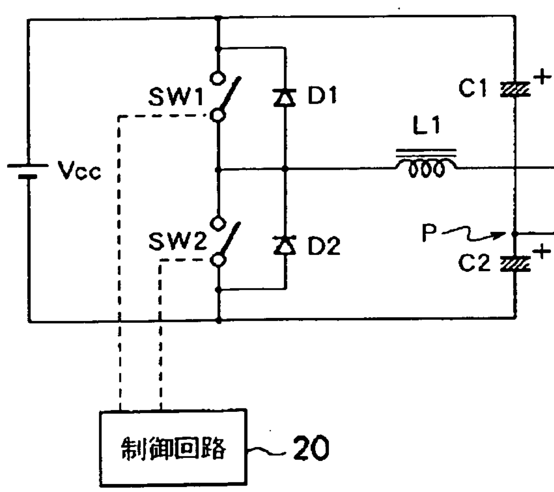
【図９】　図９はこの発明に係る交流バイアス電源装置の他の変形例を示す回路図である。

【図１０】　図１０はこの発明に係る交流バイアス電源装置の他の変形例を示す回路図である。

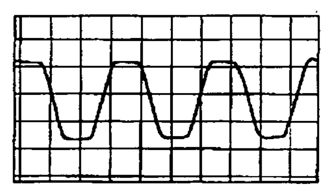
【符号の説明】

Ｔ　昇圧トランス、ＳＷ１　第１のスイッチング素子、ＳＷ２　第２のスイッチング素子、Ｄ１　第１のダイオード、Ｄ２　第２のダイオード、Ｌ１　インダクタンス

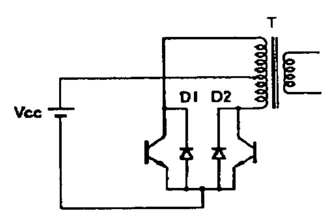
【図２】



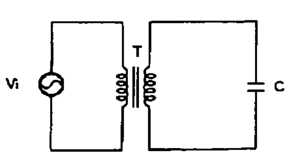
【図５】



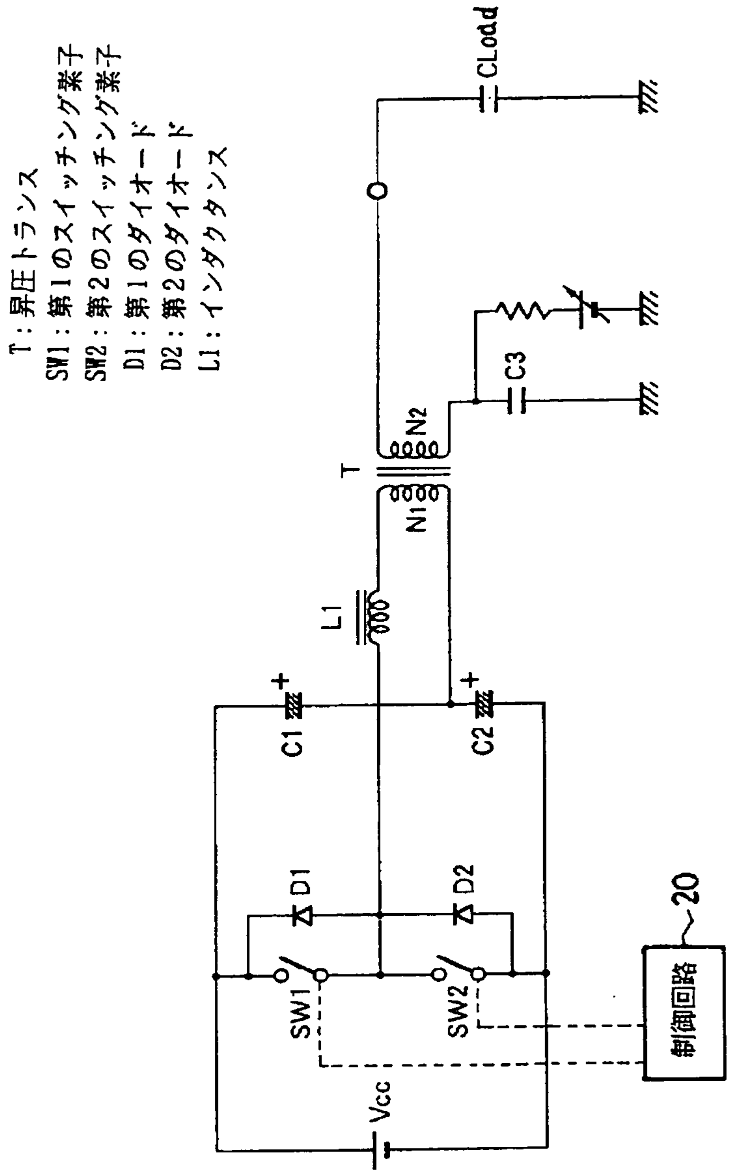
【図１０】



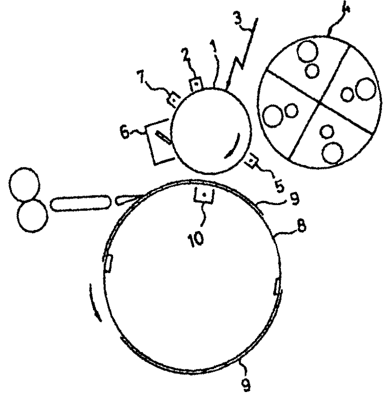
【図７】



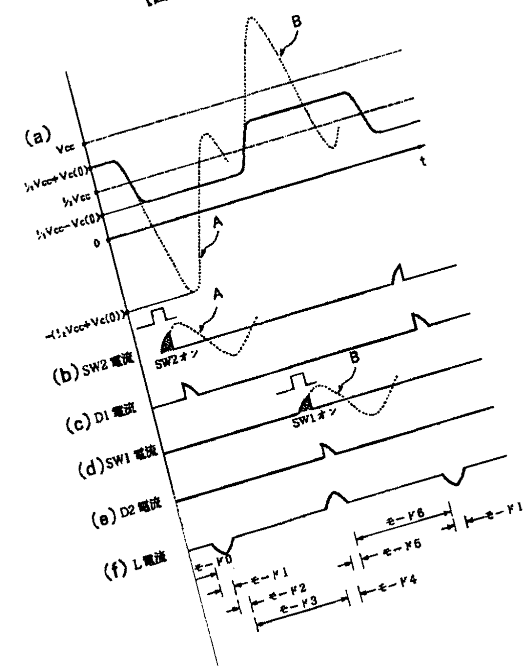
【図1】


T：昇圧トランス
SW1：第1のスイッチング素子
SW2：第2のスイッチング素子
D1：第1のダイオード
D2：第2のダイオード
L1：インダクタンス
CLoad
C3
N2
T
N1
L1
C1
C2
D1
D2
SW1
SW2
Vcc
制御回路
20

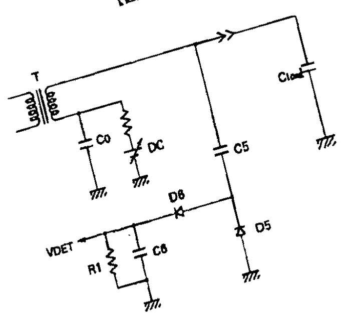
【図3】


1
2
3
4
5
6
7
8
9
9
10

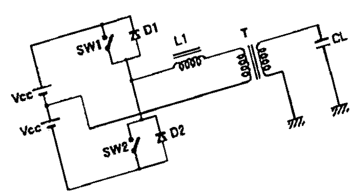
【図4】


(a)
Vcc
½Vcc+Vc(0)
½Vcc
½Vcc−Vc(0)
0
t
A
B
−(½Vcc+Vc(0))
SW2オン
SW1オン
(b) SW2電流
(c) D1電流
(d) SW1電流
(e) D2電流
(f) L電流
モード0
モード1
モード2
モード3
モード4
モード5
モード6
モード1

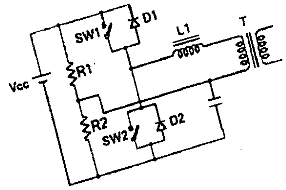
【図6】


T
Co
DC
C5
Cload
D6
D5
VDET
R1
C6

【図8】


SW1
D1
L1
T
CL
Vcc
Vcc
SW2
D2

【図9】


SW1
D1
L1
T
Vcc
R1
R2
SW2
D2